REHABILITATION OF SALTWATER CROCODILES *CROCODYLUS POROSUS* SCHNEIDER IN THE BHITARKANIKA WILDLIFE SANCTUARY, ORISSA[1]

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This paper describes the rehabilitation of the second batch of 80 young captive reared salt water crocodiles *Crocodylus porosus* Schneider into Suhajora creek of Bhitarkanika Wildlife Sanctuary during the year 1978. Monitoring of the released crocodiles reveals that they migrated downward towards the mouth of the river.

INTRODUCTION

Kar and Bustard (1990) report results of the pilot release of 15 saltwater crocodiles *Crocodylus porosus* Schneider into the Bhitarkanika Wildlife Sanctuary in April-May 1977. This provides the background to the rationale of the 'rear and release' technique in which young crocodiles measuring 1.0-1.2 m, reared from wild-collected eggs and incubated in captivity are released back into the Sanctuary (Bustard 1974, 1975). The above cited paper also provides a brief description of the Sanctuary, the release and monitoring methodology.

Detailed monitoring was carried out at night at approximately monthly intervals using a spotlight or 5-celled torch for a period of 34 months.

The present paper describes the results of the release of 80 saltwater crocodiles into the Suhajora creek in the heart of the Bhitarkanika sanctuary. This release, like the pilot release which preceded it, forms part of the Government of Orissa's Conservation Project on the saltwater crocodile, operated by the State Forest Department. This project was initiated in 1975 as a result of a report of Bustard (1974). The Bhitarkanika Wildlife Sanctuary was declared in April 1975 by Government of Orissa and the Government of India, F.A.O./U.N.D.P. Project Crocodile Breeding and Management.

MATERIAL AND METHODS

Selection of release site: The release at Suhajora creek, a 6 km, blind-ended creek near Bhitarkanika island in the core of the sanctuary, was selected as an ideal crocodile habitat, free from disturbances of any kind. This creek is 5-6 km from the nearest human habitation. Creeks in the Sanctuary are either blind-ended, end naturally or have been bunded to reduce ingress of salt water to the landward side of the bund, which is under cultivation. The latter creeks have sluice gates and are not suitable for releases (Kar and Bustard 1981). Furthermore, these bunded creeks do not appear to have suitable nesting habitat for *Crocodylus porosus.*

Timing of release: 80 crocodiles were released into the upper third of this blind-ended creek, the middle third of the creek and the lower third in three batches on three consecutive days, 26, 27 and 28 February 1978. The number of crocodiles released into each sector was 30, 26 and 24, respectively.

Selection of crocodiles for release: The crocodiles for release were hatched in 1976 and in the size class of 1.0-1.2 m. Due to a paucity of males in this year-class, the released crocodiles comprised 78 females and two males.

Action taken at the release site prior to release: Suhajora creek had been studied over the preceding three years and the resident crocodile population was known. This comprised eight crocodiles: a pair of adults, the male 18-19′ (5.5-5.8 m), the female 11-12′ (3.4-3.7 m), one sub-adult 5′4" to 6′ 4" (1.6-2.1 m) and five juveniles of approximately 1.5 m. Three of these juveniles occupy the lower third of the creek and the other two the middle third. The adult pair move between the mouth and the middle of the creek.

The top third sector of Suhajora creek, being very narrow and very shallow at low tide, is only

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substantial at the time of the fortnightly high tide. The middle portion provides good crocodile habitat throughout the tide cycles including the lower portion which is wide and deep. Both these sectors of the creek provide ideal habitat for adult, sub-adult as well as juvenile crocodiles.

Release procedure: The crocodiles for release were tail scute clipped for subsequent recognition. The method adopted (Kar and Bustard 1990) permitted identification of sex and year of release. In the present instance, the second last scute in the double scute row was clipped, the scute on the left hand side in the case of females and the scute on the right hand side in the case of males. Crocodiles were transported in damp gunny bags from the Dangmal Rehabilitation Centre to Suhajora creek, a distance of 10 km by dinghy.

Results

Released crocodiles were regularly monitored in order to record data on their movement in the wild. A total of 24 monitoring visits were made between 30 March 78 and 30 December 1980. Details of the number of released crocodiles sighted and the number estimated to be present in each third of the creek are given in Table 1. This table shows a marked downward movement of crocodiles from the first census, which was carried out approximately one month after the release. There were also downward movement trends of those individuals released in the middle sector. Movement from the lower third was comparatively very slow as this habitat was preferred by the small, release sized crocodiles. This agrees with observations on the natural population (see discussion). Some data are available on individuals which moved down to the main Bhitarkanika river.

Released crocodiles gradually moved into the main Bhitarkanika river and from there into other creeks.

Observations

1. One released crocodile (a female) was caught by net on 18 September 1978, close to Khola village by the side of the saline embankment. It was badly injured by the village people and died the following day. The distance from the release site to the end of the Khola creek, the capture site, was about 20 km.

2. A second crocodile was sighted on 24 September 1980 in an unused pond, close to Khola creek inside the saline embankment while the tide level was touching the base of the embankment. The crocodile was identified as one of the released animals by the tail scute clipping. On 27 September 1980 the pond was searched but the crocodile had left either to Khola creek or some other place.

3. Five of the 1978 released crocodiles settled in the Mainsamada creek, increasing the juvenile population to seven in the main creek.

The distance from Suhajora mouth to Mainsamada mouth is about 2 km and 6.5 km to the end of Mainsamada creek. Crocodiles were sighted in this stretch and these had spaced themselves along the creek.

After a month, less than one third (9 of 30) of the crocodiles were seen in the upper one third of the creek and it is estimated that half the crocodiles had moved from this area of the creek. The highest density of crocodiles observed was in the middle third (20 crocodiles) and lower third (22 crocodiles). Numbers had presumably increased by migration downstream from the upper third. This probability is strengthened by the high estimates (131% and 150%) for the middle and lower third of the creek, respectively.

Hence all released crocodiles were still in the creek after the first month from the date of release and were moving down the creek. After two months, the number left in the top one third was 5 (actually sighted) and 8 (27%) estimated. The number then seen in the middle one third had almost halved to 12 individuals and the estimated population dropped from 33 (131%) to 20(80%). This indicates that the many crocodiles moving out of the upper third had not established themselves in the middle third but continued migrating down the creek along with some of those released, in the middle portion. The number in the lower third of the creek reached its maximum, as 26

individuals actually observed (108%) as against only 24 released, giving an estimate of 43 (169%). That crocodiles were now moving out of this creek is apparent from the falling trend in the total number observed and estimated. These figures fell from 51 to 43 and 85 to 70 crocodiles, respectively.

In the third month, only one crocodile still inhabited the upper third of the creek. In all the subsequent survey visits, this area of the creek was completely devoid of released crocodiles. The numbers in the middle and lower third fell slightly, a trend which continued in the succeeding months although this trend was much more marked in the middle third compared to the lower third of the creek. Table 1 indicates that 11 months after release, the number in the lower third still exceeded 100% of those released (estimate 116%) whereas at this time the estimate for the middle third had fallen to 2 individuals (8%). The figure for the middle third remained at one to two sightings with an estimated population of two to three individuals for the remainder of the study.

Discussion

The difference in the time period for migration between sectors for half the released animals to have moved out, partly reflects the addition of animals moving downstream through the lower sectors from the sectors immediately above it. Hence, as stated, the upper one third sector estimate had halved after one month and was virtually at zero (estimate 2 individuals) after three months. For the middle one third sector, it took 7 months to halve and 10 months to reach virtual zero (estimate 2 animals). For the lower one third the estimate remained at 95% after one year. It reached an estimated low of three animals after 20 months, was back at five after 24 months and reverted to three after 25 months and remained so for the rest of the survey period (a total of 34 months). The above cannot be a full explanation however, for the following reasons:

1. When the number in the upper one third sector fell to virtually zero, there were no more animals available to move down into the middle portion.

2. When the middle third reached zero in July 1979, the lower third estimate stood at 116%. It took a further four months to reach 50% and from that level reached its 'base line' level of two observed (three estimated) animals in October 1979 after another five months. The lower one third, however, fell from 116% to its baseline level in nine months, as fast or faster than the middle sector.

The rate of 'loss' of animals from the creek is a slow one, clearly as a result of the gradual movement down the creek rather than an active movement out of the creek to a new locality following release.

The data in Table 1 indicates that the annual monsoonal floods were not responsible for the observed movements. The movement out of the top one third sector of the creek occurred in the summer. After the monsoon, the middle sector stood at 57% (estimate) whereas at the very end of May, immediately prior to the monsoon which commences in early June, it had stood at 69%. Similarly the lower one third sector stood at 150% immediately prior to the onset of the monsoon and had an identical figure three months after the end of the monsoon. Immediately after the monsoon it stood, little changed, at 137%.

Age of the crocodiles: Did age play a role in the gradual movement of the crocodiles out of the creek? Kar and Bustard (1990) noted that crocodiles moved down the creeks as they grew older and that by their third year they were in the lower portion of the creeks and in the main Bhitarkanika river. Since released crocodiles were all of the same age and since the movement out of the various sectors were spread over more than a full year, it cannot be held to be age specific.

The main question is, where do the crocodiles go? Messel *et al.* (1979) have stated that they move out from areas inhabited by adult crocodiles. We feel that the movement is caused by a strong territoriality of immature crocodiles themselves (Kar and Bustard 1980). This would effectively space the number of crocodiles that can settle in a given stretch of the river *Crocodylus*

TABLE 1
NUMBER OF SALTWATER CROCODILES OBSERVED AND ESTIMATED PRESENT IN EACH SECTOR OF SUHAJORA CREEK

Date of monitoring	Upper 1/3 of creek				Middle 1/3 of creek				Lower 1/3 of creek				Total number			
	Observed		Estimated		Observed		Estimated		Observed		Estimated		Observed		Estimated	
Release: 26-28 Feb. 1978	30		(100)		26		(100)		24		(100)		80		(100)	
30 Mar.1978	9	(30)	15	(50)	20	(77)	33	(131)	22	(92)	36	(150)	51	(64)	85	(105)
29 Apr. 1978	5	(17)	8	(27)	12	(46)	20	(80)	26	(108)	43	(169)	43	(54)	70	(84)
30 May 1978	1	(3)	2	(7)	11	(42)	18	(69)	22	(91)	36	(150)	34	(42)	57	(70)
28 Aug. 1978	0		0		7	(27)	11	(42)	21	(87)	35	(140)	28	(35)	46	(57)
29 Sep. 1978	0		0		9	(35)	15	(57)	20	(83)	33	(137)	29	(36)	48	(60)
29 Oct. 1978	0		0		8	(31)	13	(50)	16	(67)	26	(108)	24	(30)	40	(50)
27 Dec. 1978	0		0		4	(15)	6	(23)	22	(92)	36	(150)	26	(32)	45	(56)
29 Dec. 1978	0		0		3	(12)	5	(19)	20	(83)	33	(137)	23	(29)	38	(47)
30 Jan. 1978	0		0		1	(4)	2	(8)	17	(71)	28	(116)	18	(22)	30	(37)
26 Feb. 1979	0		0		1	(4)	1	(4)	14	(58)	23	(95)	15	(18)	25	(31)
30 Mar. 1979	0		0		1	(4)	2	(8)	13	(54)	18	(22)	14	(17)	23	(29)
28 Apr. 1979	0		0		1	(4)	2	(8)	10	(41)	17	(71)	11	(13)	18	(22)
25 May 1979	0		0		1	(4)	2	(8)	7	(29)	12	(50)	8	(10)	13	(16)
29 Aug. 1979	0		0		2	(8)	3	(11)	4	(16)	7	(29)	6	(7)	10	(12)
26 Aug. 1979	0		0		2	(8)	3	(11)	3	(12)	75	(21)	5	(6)	8	(10)
30 Sep.1979	0		0		2	(8)	3	(11)	3	(12)	5	(21)	5	(6)	8	(10)
28 Oct. 1979	0		0		1	(4)	3	(11)	3	(8)	3	(12)	3	(3)	5	(6)
27 Feb. 1980	0		0		1	(3)	2	(8)	2	(12)	5	(21)	4	(5)	7	(9)
29 Mar.1980	0		0		1	(3)	2	(8)	3	(8)	3	(12)	3	(3)	5	(6)
28 May1980	0		0		1	(3)	2	(8)	2	(8)	3	(12)	3	(3)	5	(6)
30 July 1980	0		0		1	(3)	2	(8)	2	(8)	3	(12)	3	(3)	5	(6)
29 Sep. 1980	0		0		1	(3)	2	(8)	2	(8)	3	(12)	Rest left		5	(6)
28 Nov. 1980	0		0		1	(3)	2	(8)	2	(8)	3	(12)	into the		5	(6)
30 Dec. 1980	0		0		1	(3)	2	(8)	2	(8)	3	(12)	main river		5	(6)

Estimates are based on assumed sightings of 60% of crocodiles under survey conditions.
Percentages are shown in parentheses. All monitoring results are for crocodiles released in 1978.

porosus is a solitary animal (Kar 1981) and strongly territorial from its third year (Kar and Bustard 1980).

The problem which we are unable to resolve at present is that given a creek with no disturbance factors and possessing ideal crocodile habitat such as Suhajora, why is the number of crocodiles in the creek very low? Good survival rates of released crocodiles have been demonstrated over a period of two years (Kar and Bustard 1990). Suhajora creek is approximately 6 km long and 4 km of this is good habitat with a resident population of five juveniles, one sub-adult and one pair of adults.

It is estimated that five of the released crocodiles remained in Suhajora creek. Along with the existing population the total of 13 individuals gives a density of only three crocodiles per kilometre.

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